



# Afghanistan Energy Study

## Activity 3: Household and Enterprise Surveys

### Intermediary Results



# Agenda

- Research questions & methodology
- Locations and fieldwork
- Respondent profile
- Energy usage
- Energy profile
  - Grid
  - Solar
  - Generators & batteries
- Aspirations in terms of energy access
- Preliminary findings on Willingness to pay
- Next steps



# Research Questions

## **Energy usage and consumption patterns**

How much energy do households, enterprises and community institutions use? For what?

What is the source of energy in different locations and by different demographics?

To which extent do different options currently exist, and what arbitrage is used to decide between them?

How do energy consumption patterns vary depending on the time of the year?

How do energy consumption patterns vary depending on factors such as household demographics and wealth patterns?

## **Cost of energy, and willingness to pay**

What is the current cost of energy for the different target groups, and how is it paid for?

How much do they stand to gain from improved energy provision?

How much would they be willing to / could they afford to pay for said improvement?

## **Business Enterprise and Community Institutions (BE&CI)**

What do business enterprises and community institutions currently use energy for?

What could BE&CI do if energy supply was scaled up and made more affordable?

What is BE&CI willingness to pay for different energy solutions?

How reliable is this source of energy? How does this impact on business activities?

# Locations

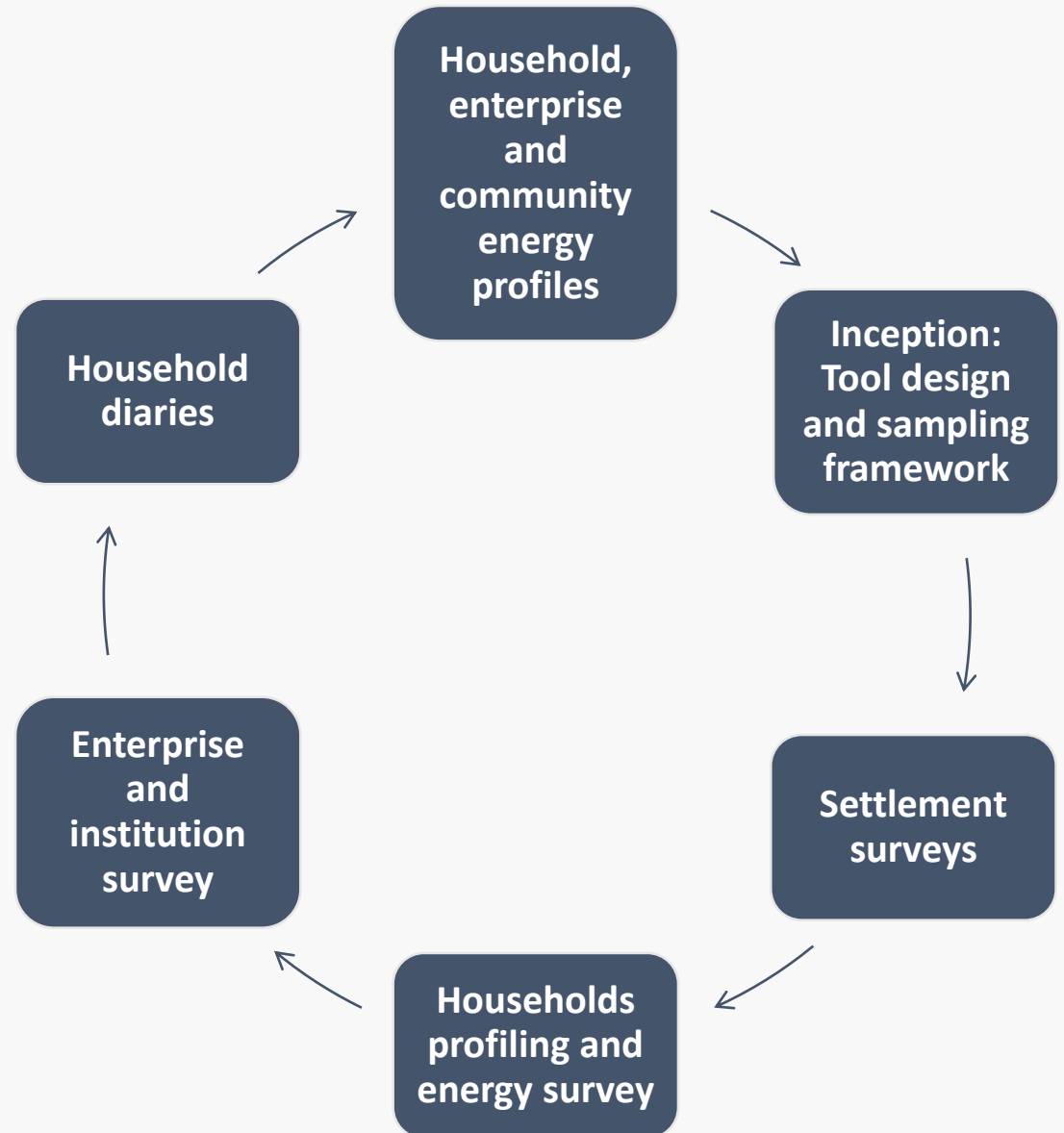
Electrification rates	Provinces
Highest	<b>Kabul</b> , Balkh, Kandahar, Kunduz (and Herat)
Expected to grow	Badakhashan, Baghlan, Faryab, Helmand, Jowzjan, Laghman, Nangarhar, Parwan, <b>Samangan</b> , Sar-e-Pol, Takhar, and Wardak.
Connection to the grid possible	Badghis, Bamyan, Ghazni, Ghor, Kapisa, Khost, Kunar, Logar, <b>Paktia</b> , Paktika Panjshir, Uruzgan, and Zabul
Connected to Iran	Nimruz, <b>Herat</b>
Off-grid solutions	Nuristan, <b>Daykundi</b> , Fayab

- ✓ Provinces selected to represent different electrification characteristics
- ✓ Communities randomly selected within provinces following security assessment, and stratified for location (rural and urban)
- ✓ Respondent households randomly sampled through grid approach
- ✓ Purposeful selection of businesses and institutions





# Tools and methods



[illegible][illegible]

# Challenges encountered

## 1. Security

- ❖ Attacks against voting centers in Kabul
- ❖ Clashes in Paktia
- ❖ Mujahedin in Daikundi
- ❖ Armed men in Paktia

## 2. Logistics

- ❖ Outages
- ❖ Mobile network coverage

## 3. Do no harm

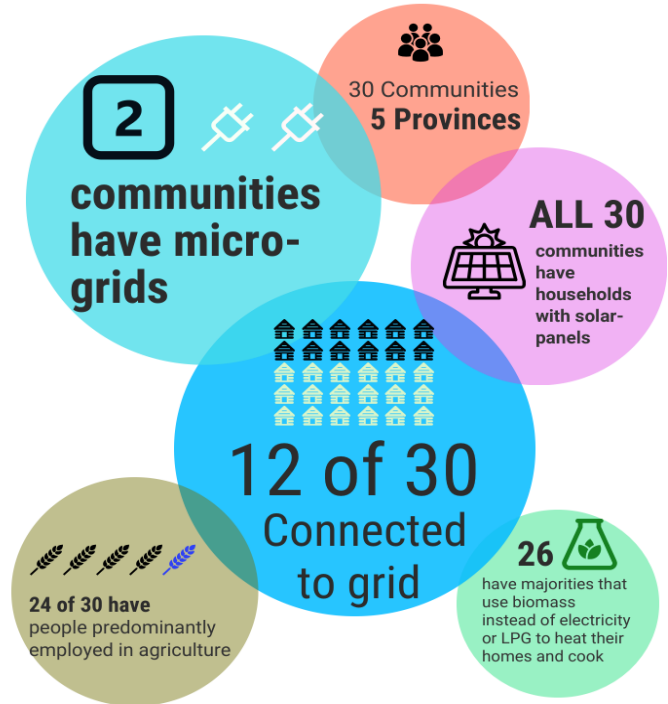
- ❖ Feelings of exclusion by non-surveyed individuals



# A variety of locations



## Communities by the Numbers





# Profiled communities

## Kabul

- ✓ Dasht-e-Barchi
- ✓ Karte Naw
- ✓ Khair Khana
- ✓ Deh Yahya
- ✓ Langar
- ✓ Shewaki



## Herat

- ✓ Jebraeel
- ✓ Shaalbafaan
- ✓ Naw Abad Shuhadaye
- ✓ Qala-e-Sharbat
- ✓ Majghandak
- ✓ Malikiha



## Samangan

- ✓ Chawghai
- ✓ Mula Qurban
- ✓ Dalkhaki
- ✓ Lab-e-Aab
- ✓ Yakatoot
- ✓ Dawlatabad



# Profiled communities

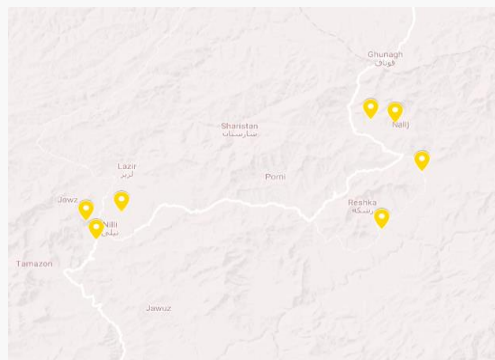
## Paktia

- ✓ Baala Deh
- ✓ Bano Zai
- ✓ Habib Kala
- ✓ Mandokhail
- ✓ Narqese
- ✓ Patan Kalai



## Daikundi

- ✓ Qarya-e-Dasht
- ✓ Sang-e-Mum
- ✓ Sar-e-Nili
- ✓ Khuja Chasht
- ✓ Ghaaf
- ✓ Charkh



**Ashraf Ghani** @ashrafghani · Apr 1

Inaugurated the Arghande-Gardez power line (220 KW) and Gardez Sub-station (220 KW).

The general capacity of the power line is 300 MG, currently delivering 32 MW electricity to 40 thousand families in Logar, Paktia and Khost.



42 55 491

Show this thread

# Respondent Profile: Households

- 3,061 households - close to 50% of the household respondents women
- **Most prevalent livelihood sector:** agriculture (32%), construction (30%), trade (16%), public sector (13%). 16% have some kind of home-based IGA (commonly related to tailoring and embroidery)
- **Average monthly income** per household member AFN 1,800 (median 1,300) – this income is highly seasonal
- Dwellings most commonly single-story houses occupied (and owned) by one household. **Most prevalent construction material:** mud bricks, and wooden roof.





# Respondent Profile: Businesses & Institutions

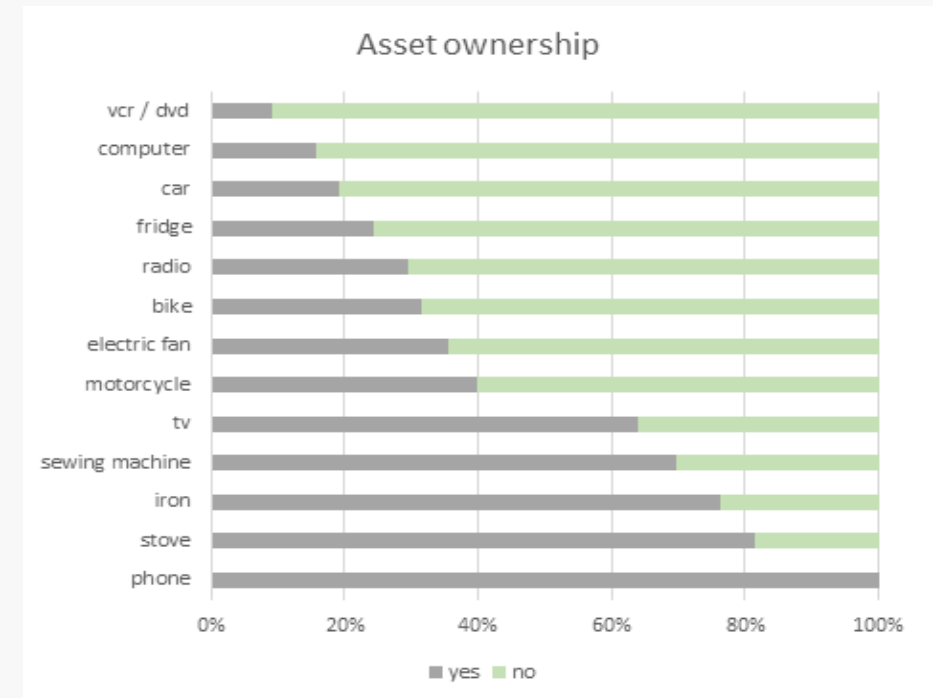
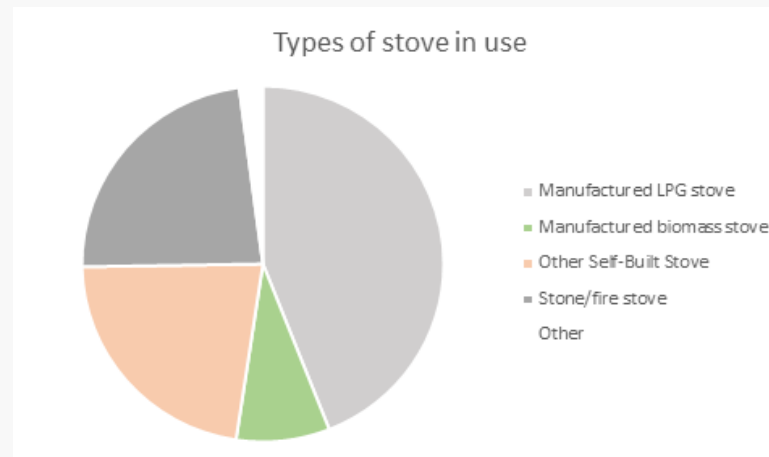
- 179 businesses of different sizes (including grocery stores, metal workshops, tailors, computer repair, ice cream parlours, gas stations ...)
- 74 community institutions (including schools, mosques, health facilities, public offices ...)
- Establishments are active year-round, for eight hours or more per day
- Reported income and operational costs vary widely
- Most B&I establishments occupy a single-story building by themselves. Size varies, at around 6x4m for businesses and 40x25m for community institutions





# Energy Usage: Households

- Lighting is the most important professed need
- Stoves most often run on gas, but more than one fuel is used for cooking
- Most common space heating solutions: bukhari, sandali, tabakhana
- Most common fuel for heating : wood and dung
- Most common electric asset: Television
- Ubiquitous: cellphones



# Energy Usage: Households

***We use liquid gas for cooking. But if we can find other materials for cooking like wood, animal droppings and anything else, then we will use that as well to save our money.***

*Woman from Malikiha, Herat*

***We use coal in a sandali to warm the room, but it is dangerous and we get headaches from it. We use dung for cooking, but this causes breathing issues and eye problems.***

*Woman from Khwaja Chasht, Daikundi*



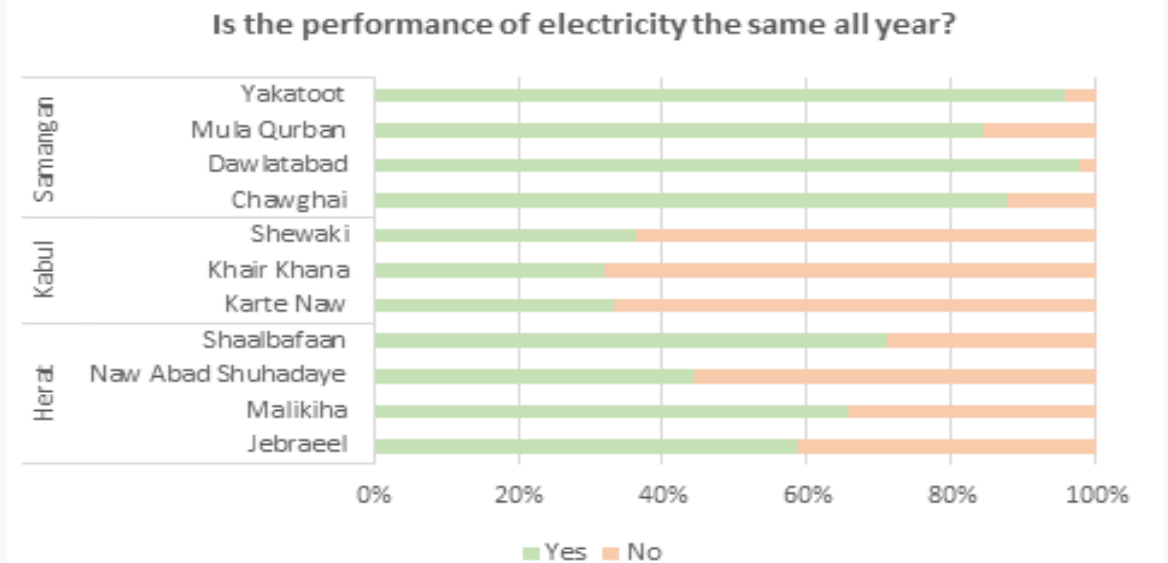
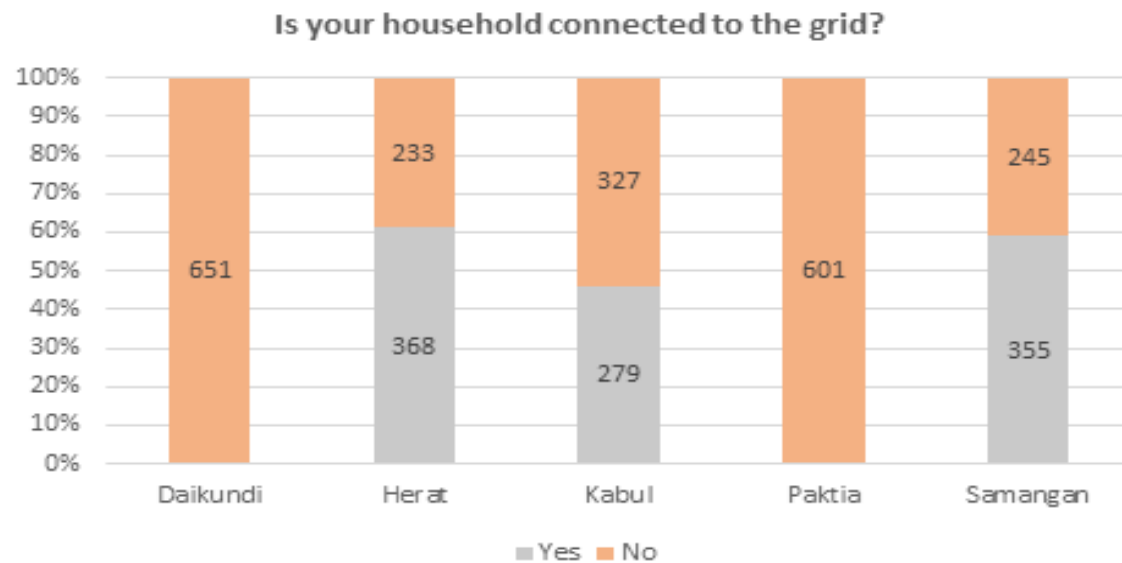
# Energy Usage: Businesses & Institutions

Most important use of energy:  
lighting (68%), computers  
(67%), space cooling (41%) and  
product cooling (29%)



# Energy Profile: Grid Electricity

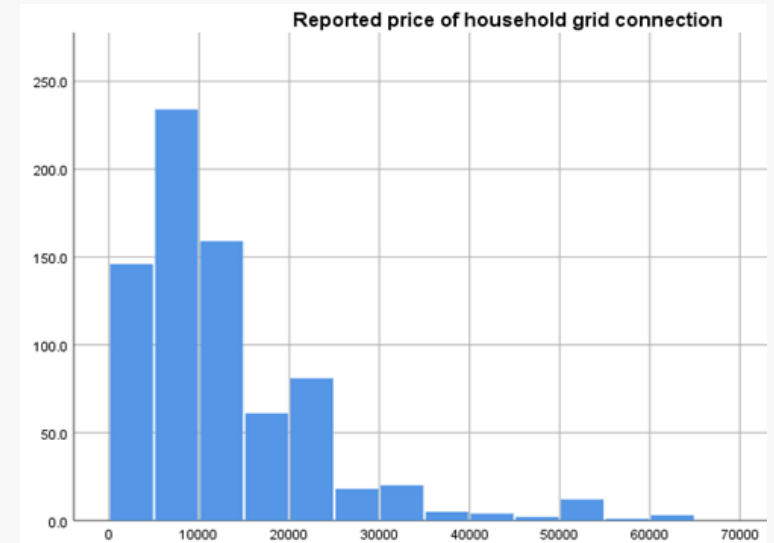
- One third of surveyed households are connected to the grid
- No grid in Daikundi and Paktia
- Seasonal variations particularly strong in Kabul
- Almost everyone reported having a working meter





# Reported Cost: Grid Electricity

- Reported price of grid connection fluctuates around a median of AFN 9,000 – much higher than the official cost (AFN 3,500 to 6,000)
- Reported cost per kW roughly (!) in line with official DABS figures:



		households			Businesses / institutions		
		invoice	usage	Reported cost / kW	invoice	usage	Reported cost / kW
N	Valid	939	594	592	81	71	71
	Missing	2122	2467	2469	172	182	184
Mean		2441	456	7.6	10315	741	14.9
Median		1391	200	5.6	3138	276	9.6
Std. Deviation		3539	1411	11.5	23193	23193	9.6

## The price of electricity depends:

- 0-200 kW: AFN 2.5 per kW
- 201-400 kW: AFN 3.70 per kW
- 401-700 kW: AFN 5.75 per kW
- 701-2000 kW: AFN 8.25 per kW
- Above 2000 kW: AFN 10 per kW

**The rate for commercial and government is AFN 12 per kW no matter what their consumption.**

*DABS power engineer*



# Problems: Grid Electricity

- Supply and grid interruptions in Kabul
- Cost in Herat
- Businesses and institutions lose tools and appliances due to voltage fluctuations

*Gas is expensive to use, but we can't use the electricity for all our needs because it's quite expensive. It's more comfortable to use than anything else, but it just costs too much.*

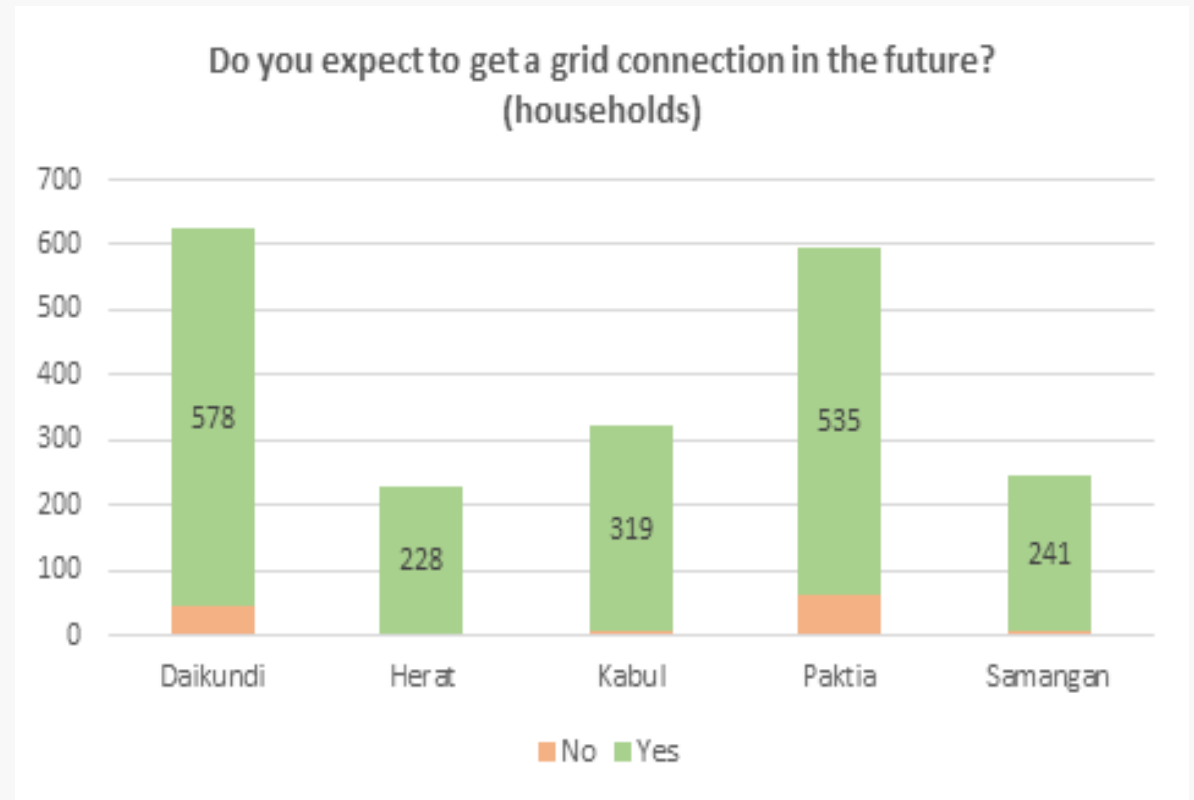
*FGD, Shaalbaafan, Herat*

*Our electricity disconnects many times in a day which can cause damage to our electronic devices. (...) Our main problem with electricity is... the lack of electricity! Sometimes when we want to make bread we make dough and then we wait all day for electricity. In winter, most of the days we won't have electricity because of technical problems. During the days in winter we will have only 5 to 6 hours electricity.*

*FGD, Karte Naw, Kabul*

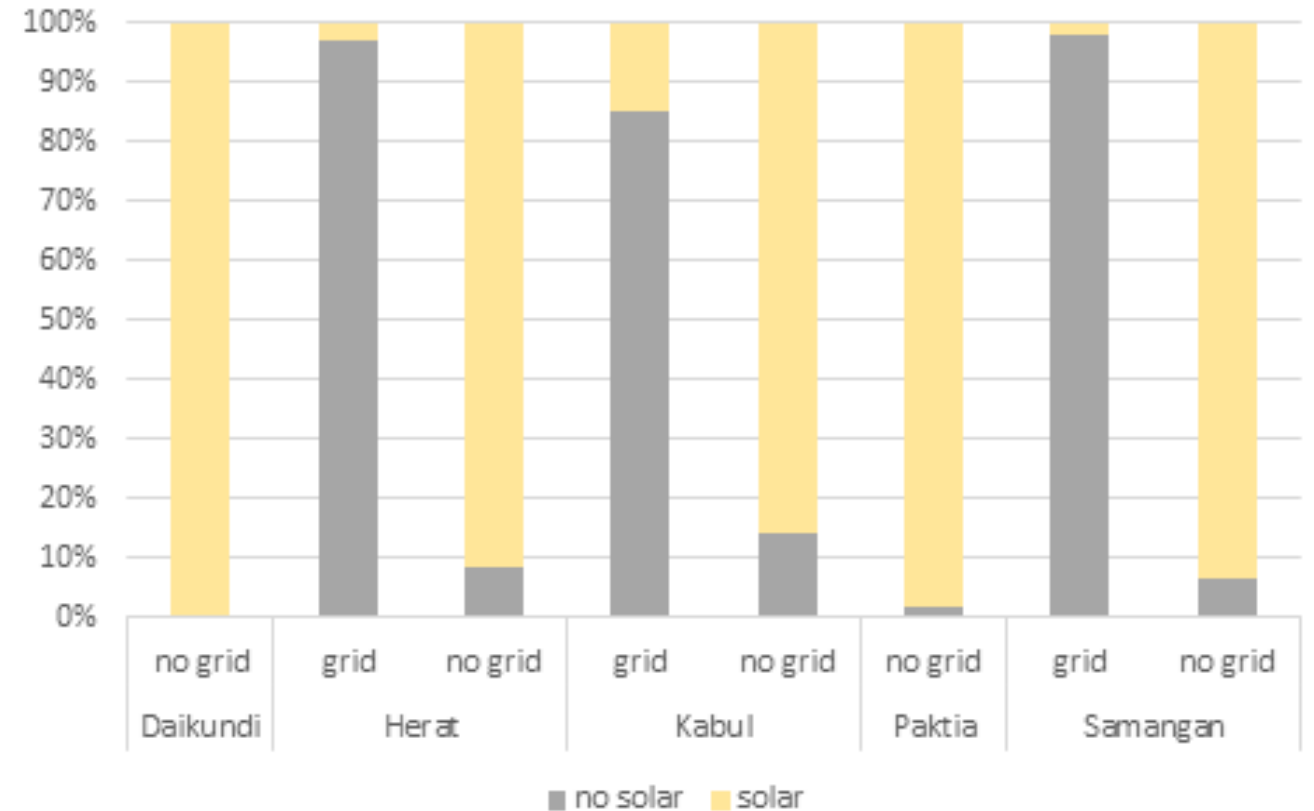
# Aspirations & Expectations: Grid Electricity

Almost without exception, **those who are not currently connected to the grid expect to be within two to three years.**



# Energy Profile: Solar Energy

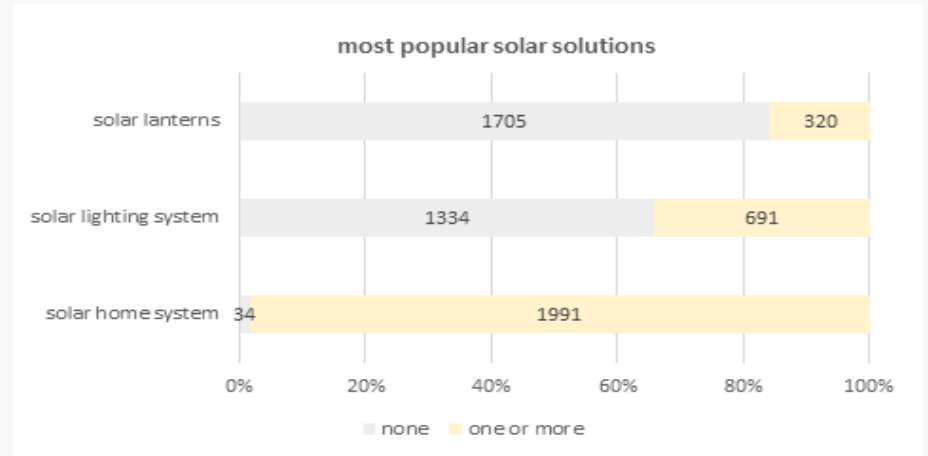
- By far the most common energy solution encountered: **two thirds of household respondents own a solar device**
- More common for households than for businesses and institutions
- Prominence of solar inversely related to prominence of grid





# Solar Home Systems

- By far the most prevalent solar solution
- Mainly Chinese and Iranian
- Generally owned (not rented)
- Six years old on average



		Width panel	Length panel	capacity	Purchase price
N	Valid	2007	2008	1778	1598
	Missing	1054	1053	1283	1463
Mean		60	98	90	9438
Median		50	100	70	7000
Std. Deviation		28	50	60	9498

# Problems: Solar

*The only energy source we have at home is solar. It is not sufficient to operate the washing machine, water pump and other electric machines. If we increased the number of solar panels, we could do so but otherwise it is too weak.*

*Focus group, Kabul*

*Solar energy has a lot of fluctuations. Lights get damaged, as often as three times a week. Each time it costs us AFN 100 to replace. I know a shopkeeper whose place burned down because of solar. The solar device we use now cost AFN 3,500 and we have had it for five years. But we have had to change the battery after one year.*

*Focus group, Daikundi*



➔ Solar is perceived as an interim solution. Those who have grid do not have solar. Those who have solar are eager to shift to grid.

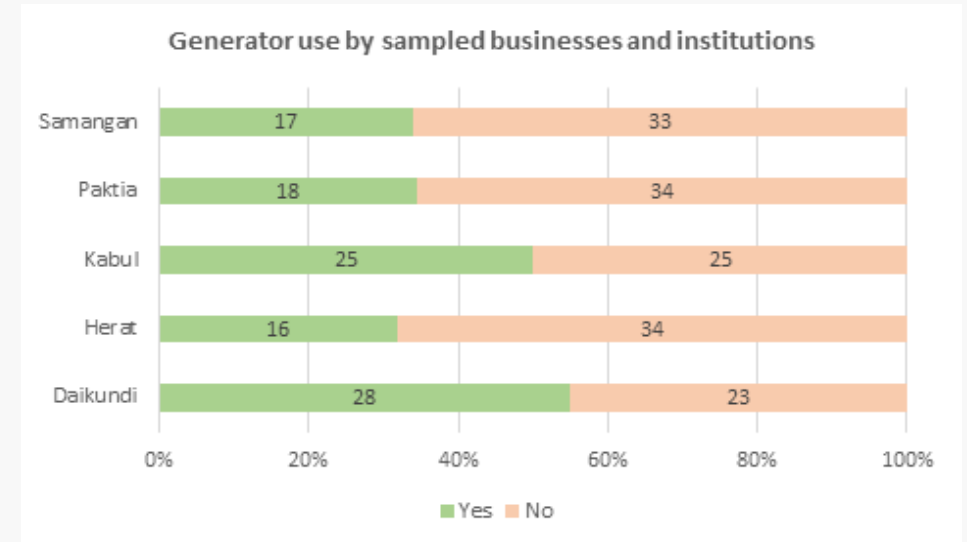
# Generators: Household Use

- Generators are rare ( $\approx 100$  out of over 3,000 households)
- Mainly used in the colder months (backup for grid)
- Reported price: AFN 14,000 on average (median AFN 11,000)
- Usually fueled by gasoline, which is readily available for AFN 40-50 per litre
- They have often been in use for many years, generally for no more than three hours per day
- Main issue: the noise



# Generators: Business & Institution Use

- More frequent than for households, particularly in Kabul and Daikundi
- Average price of AFN 39,000 (median of AFN 27,000)
- Main reported issues: breaks easily, strong fluctuations in supply, can damage tools... and cost



*We use a 6.6 horsepower generator , it can produce 7.5 kW power. We use it in the mornings, and from six to noon it uses up two liters of diesel. The cost is AFN 50 per liter. We use our generator to power the TV, the lights and the water pump. We have 45 lights - solar energy would not be strong enough to power these all at once.*

*Hotel owner, Daikundi*



# Rechargeable Batteries

- Battery usage is rare: only 3.4% of respondents state that they are part of their energy mix.
- Distinction with solar is not clear
- Batteries are not deemed strong enough to power large appliances – this is considered their most important limitation
- They are mainly used for lighting and charging mobile phones





## What about mini-grid?

- Hardly encountered in the sample: 42 households, mainly in Kabul
- Powered by diesel

*Here we have local generator electricity that can switch on one television and three lights. Its price is 900 Afghanis each month. Every night, we have electricity for two and half hours. It stops at 9 pm every night.*

*FGD, Dasht-e Barchi, Kabul*

## What about pico-hydro?

- Hardly encountered in the sample: 54 households, mainly in Kabul & Herat
- Shared systems plagued by seasonal variations

# Exceptional? The pico-hydro system in Sar-e-Nili...

In 2011, CDC uses development funding to build a hydro mini-grid system

One month later, the system ceases to work

Parts get stolen

The system has not worked since

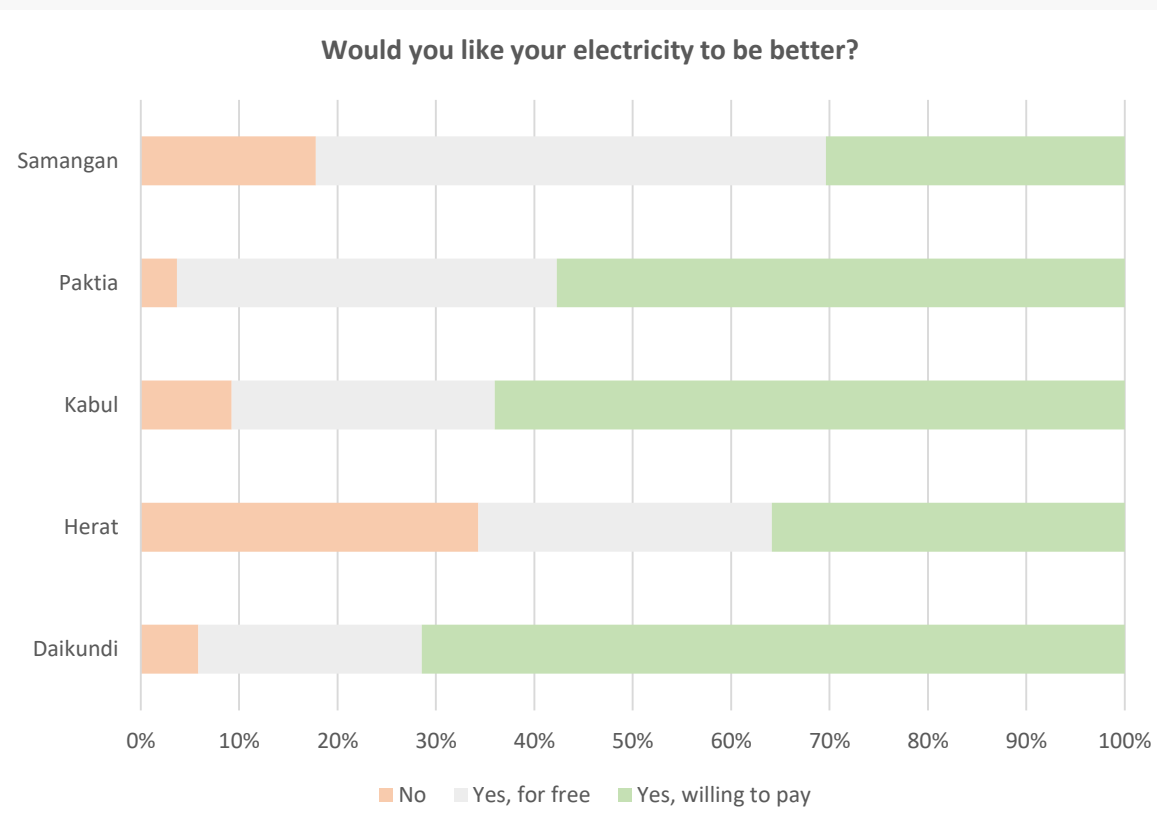


# Aspirations: Households

Aspired-to improvements focus on chores, entertainment and communication (over education, work and health)

*If we could have better electricity, then since we have a washing machine, but since we don't have enough electricity we can't do that. And we also have water tank - if we had better electricity we could buy a water pump and use it to fill the tank with water. And, if we could have better electricity, we could use it in winter for heaters and cooking. In summer we could use the refrigerator, and we could watch television, and we could study using a computer!*

*Women's FGD, Sar-e Nili, Daikundi province*



Potential gains in agriculture

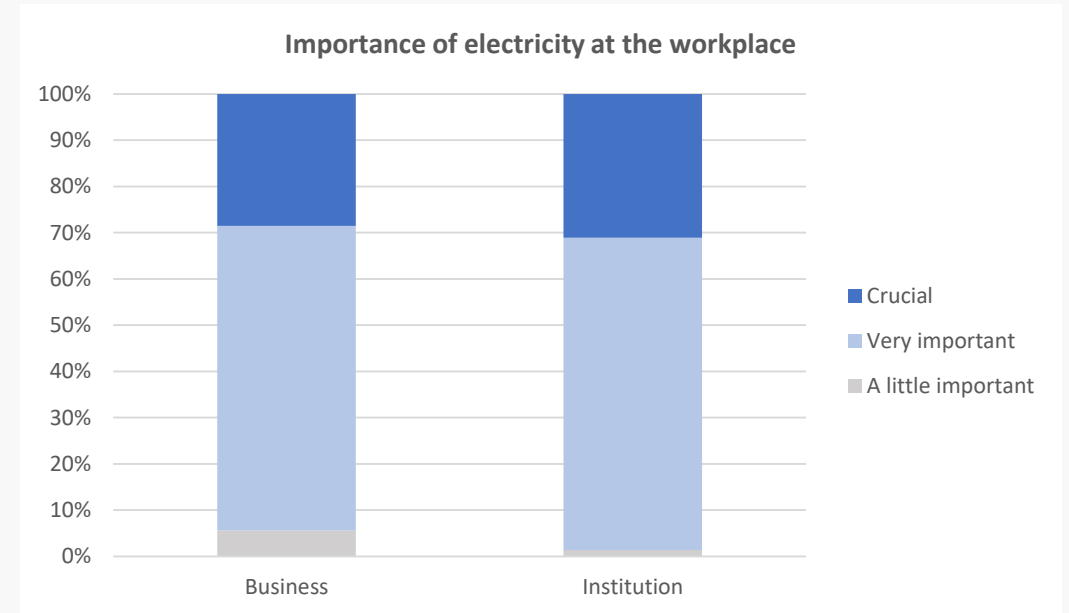
Potential gains in home-based economic activity



# Aspirations: Businesses & Institutions

Respondents note that their business, and their sector as a whole, would grow a lot if supply of electricity became better, and more affordable.

Ambitions: upgrade equipment (70%), work longer hours (60%), employ more people (30%).



*I have invested AFN 150,000 in this business. The diesel generator alone cost 30,000. A large part of my income every month is spent on fuel. If I had access to the grid, I would halve my operating costs and double my profit.*

*Icecream salesman, Daikundi*





# Potential Welfare Impacts

Based on preliminary results of baseline data analysis, being connected to the grid appears to significantly:

- **Improve income** (+8% in food expenditure per person per week)
- **Increase productivity**, freeing up time spent on household tasks
- **Reduce income fluctuations**
- **Reduce the likelihood of child labour** (-19%)

Impact of grid connection on welfare (IV regressions)

	Income			Human capital	
	(1)	(2)	(3)	(4)	(5)
	food expenditures (ln)	Income fluctuations	Working person (%)	Child labour (%)	School attendance (%)
<b>Correction for endogeneity (IV)</b>					
Household is connected	0.802** (0.338)	-0.742* (0.416)	0.004 (0.045)	-19.640** (7.878)	9.297 (19.940)
Observations	2,982	2,982	2,971	2,364	1,577
R-squared	0.235	0.077	0.152	0.024	0.06

**IV for household connection:** distance to the nearest road, mean number of outages at the village level

**Control variables:** % of shared grid in the village, village is connected to the grid, urban, region, dar language, ethnicity, at least one man is literate, at least one woman is literate, household size, agricultural household, migrant household, house is made of mud

Standard errors in parentheses, clustered at the village level

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1



# Willingness to Pay

Investigated for grid connection (immediate and paid for over six months), solar home systems (for rent and financed over 24 months), solar lantern.

## Method:

Every respondent was presented a hypothetical price between 0 and the actual market-based cost of the service / device. This simulates different levels of subsidy.

**Simple question:** *Would you, or would you not, be able and willing to pay this price for this service / device?*

# Example: WtP for immediate grid access

**Sample:** households who are not currently connected to the grid

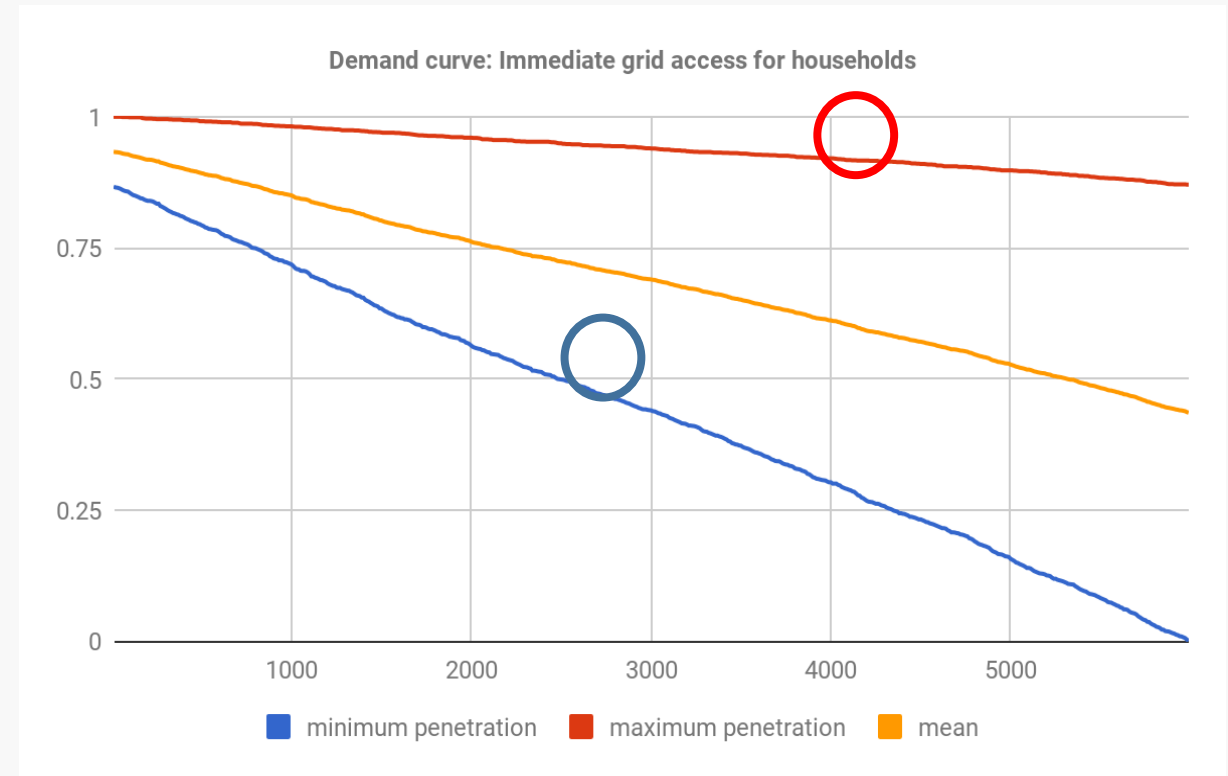
**Maximum value:** AFN 6,000

**BLUE LINE:** % of respondents who would be willing to pay the quoted price, or a higher one

*(i.e. 50% of interviewed households said they would be willing to pay AFN 2,500 or more to be connected to the grid immediately)*

**RED LINE:** % of respondents who would not be willing to pay the quoted price)

*(i.e. 90% of interviewed households said they would NOT be willing to pay AFN 4,000 to be connected to the grid immediately)*

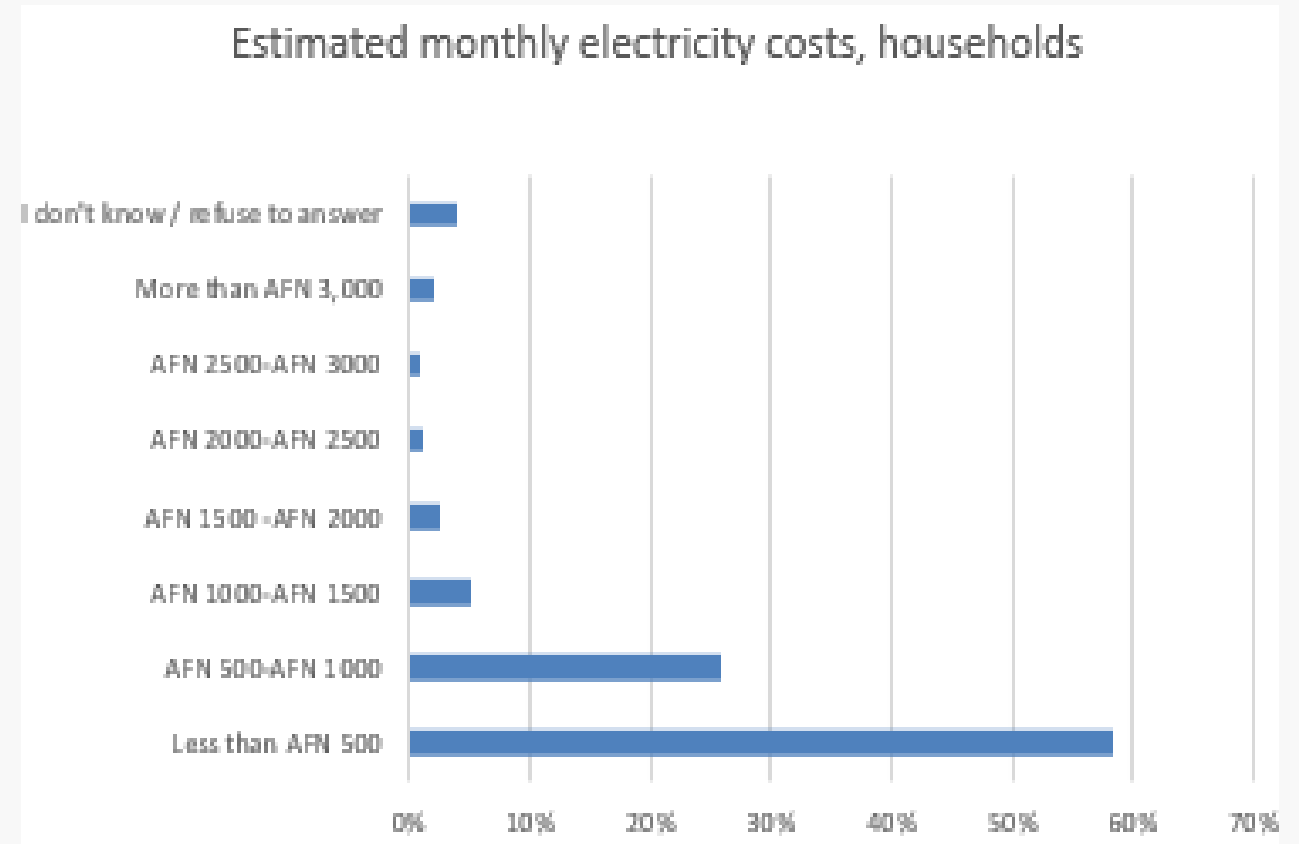


**RESULTS ON THIS WILL BE FURTHER REFINED IN THE WEEKS AND MONTHS TO COME**

## Monthly spending on electricity: estimates by household respondents not currently connected to the grid

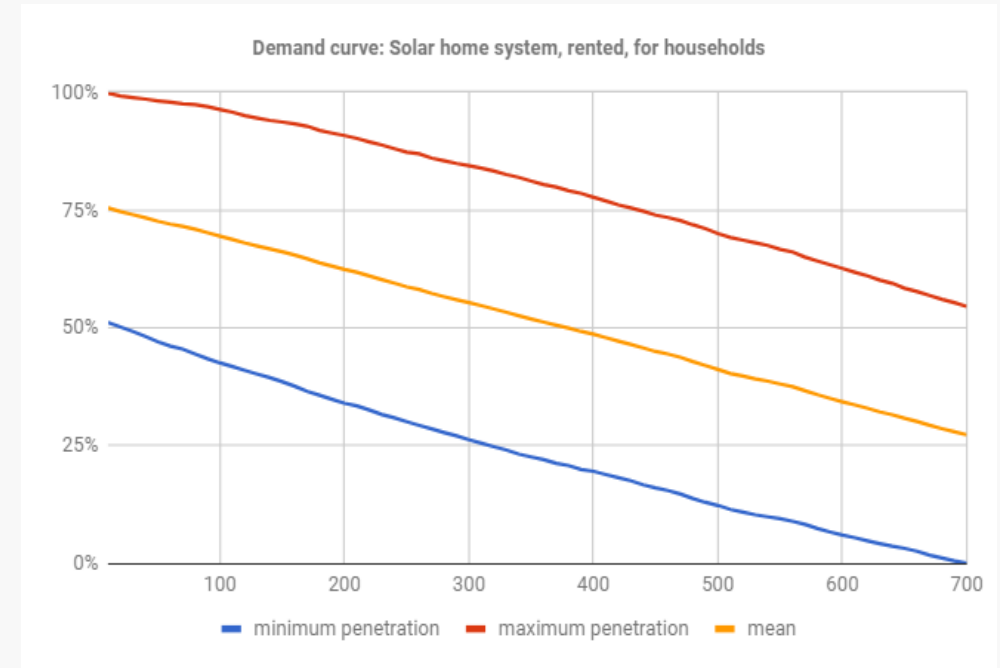
Those who do not have electricity expect that monthly cost will be quite modest.

*(Less than AFN 500 for households, less than AFN 1,000 for businesses / institutions.)*



# WtP for an SHS for rent

- Willingness to pay for solar is limited
- Half of household respondents are not eager to obtain a SHS for free
- Those who have grid do not feel they need solar, those who do not have grid already have solar... and expect to soon have a grid connection

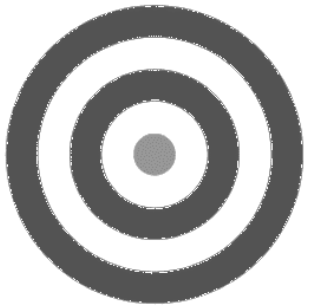


***Within three years after getting grid power, all of us sold our old fuel lanterns, solar home systems and solar lanterns at the bazaar in Aybak. We all use grid now. No one has a stand-alone power system anymore.***

*Shura member in Dawlatabad, Samangan*

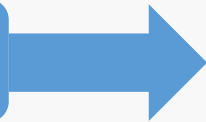


# Next steps in our year-long research: Diary Phase



**Goal:** Over the course of one year starting in July 2018, collect regular records on energy usage from a maximum number of businesses/enterprises and households profiled in phase 1.

## Challenges



- Attrition
- Incentives
- Illiteracy
- ...

**Over the course of twelve months, we will collect daily information from each household for one week per month. We will use different methods in order to be able to triangulate information.**



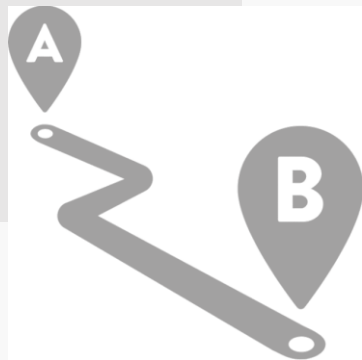
# Areas to be further investigated in the months to come

**Diary survey**, once a month, one week recall period, targeting all profiled respondents:

- Changes in energy access and availability
- Energy usage
- Energy spending
- (Narrowing down willingness to pay)

**Case studies**, once every three months (seasonal), targeting ten households with different profiles of interest :

- Gendered impact of energy usage
- Energy and education
- Energy and income generation
- Energy and health
- Deep dives into challenges and aspirations



# THANK YOU VERY MUCH

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